Research Paper | Engineering | E-ISSN No : 2454-9916 | Volume : 10 | Issue : 10 | October 2024

CNN-POWERED MARATHI SIGN DIALECT ACKNOWLEDGMENT AND TRANSLATION

Prof. Snehal Mangale[1], Raj Kashid[2], Aditya Kamble[3], Vaishnavi Jangam[4], Mohan Kharat[5]

[1,2,3,4,5] Department of Computer Engineering, Dr. D. Y. Patil College of Engineering & Innovation, Talegaon, India

ABSTRACT

This paper presents a comprehensive review of recent advancements in Marathi Sign Dialect (MSL) recognition and interpretation, focusing on the application of Convolutional Neural Networks (CNNs). Existing research demonstrates the effectiveness of CNNs in extracting and classifying features from MSL gestures, leading to promising accuracy rates. Despite these advancements, challenges such as data scarcity and the inherent complexity of MSL remain. To address these limitations, future research should explore hybrid approaches that integrate CNNs with Recurrent Neural Networks (RNNs) and Long Short-Term Memory (LSTM) systems. By combining the strengths of these techniques, we can anticipate further improvements in MSL recognition and interpretation, ultimately enhancing communication accessibility for the Marathi sign language community

KEYWORDS: Marathi Sign Dialect, Convolutional Neural Networks, Gesture Recognition, Data Scarcity, Hybrid Approaches

INTRODUCTION

The communication gap between hearing and deaf individuals remains a significant barrier in society, often leading to misunderstandings and social isolation. In Maharashtra, India, the Marathi Sign Dialect (MSL) is a vital visual language for the deaf community, yet its acknowledgment and interpretation pose unique challenges. Current methods of communication often fail to provide accurate and accessible solutions for MSL users, underscoring the need for more effective technological interventions. Recent advancements in artificial intelligence and computer vision have shown promise in addressing these challenges. Convolutional Neural Networks (CNNs) have emerged as a powerful tool for visual recognition tasks, enabling the extraction and classification of complex visual features. However, while existing research demonstrates the potential of CNNs in recognizing MSL gestures, significant gaps remain. Issues such as data scarcity, variability in hand gestures, and the demand for real-time processing limit the effectiveness of current acknowledgment systems. This review paper aims to fill these gaps by providing a comprehensive examination of the application of CNNs in MSL acknowledgment and interpretation. By highlighting key contributions, identifying ongoing challenges, and proposing future directions, this research seeks to enhance communication accessibility for MSL users. The study posits that integrating advanced CNN techniques can significantly improve the accuracy and efficiency of MSL recognition, ultimately fostering better communication between hearing and deaf individuals

METHODOLOGY

1. Data Acquisition and Preprocessing:

a. Dataset Collection:

1. A comprehensive dataset was curated, including diverse signers, lighting conditions, and sign language variations to ensure robust model training and generalization.

b. Data Cleaning and Augmentation:

1. The data was cleaned to eliminate noise and artifacts, enhancing quality.
2. Data augmentation techniques were used to artificially increase dataset size and improve model robustness.

c. Hand Region Extraction:

1. Techniques like deep learning-based segmentation and skin color detection were used to accurately isolate the hand region from the background, ensuring precise feature extraction.

2. Feature Extraction and Selection:

a. Convolutional Neural Networks (CNNs):

1. State-of-the-art CNN architectures like VGGNet and ResNet were employed to extract discriminative features from preprocessed hand images.

b. Feature Engineering:

1. Additional feature engineering techniques were explored beyond CNN features, including optical flow analysis for capturing temporal information and spatial features for capturing relationships between hand parts.

c. Feature Selection:

1. Dimensionality reduction techniques like Principal Component Analysis (PCA) and t-SNE were considered to identify the most informative features and improve computational efficiency.

3. Model Training and Optimization:

a. Transfer Learning:

1. Pre-trained CNN models were fine-tuned using the Marathi Sign Language (MSL) dataset to accelerate training and improve performance.

b. Hyperparameter Tuning:

1. Systematic grid search and random search methods were employed to optimize hyperparameters such as learning rate, batch size, and network architecture.

c. Regularization Techniques:

1. Dropout and L1/L2 regularization were incorporated to prevent overfitting and improve model generalization.

4. Model Evaluation and Refinement:

a. Performance Metrics:

1. Evaluation metrics like accuracy, precision, recall, F1-score, and confusion matrix were used to assess the model's classification performance.

b. Cross-Validation:

1. K-fold cross-validation was employed to evaluate the model's generalization ability and prevent overfitting.

c. Error Analysis:

1. Misclassified samples were thoroughly analyzed to identify patterns and improve the model by addressing specific weaknesses.

5. Integration with Text-to-Speech and Speech-to-Text:

a. Optimization:

1. System optimization for real-time performance was done by considering hardware capabilities, algorithm efficiency, and data preprocessing techniques.

b. Hardware Acceleration:

1. The use of specialized hardware, such as GPUs or TPUs, was explored to enhance performance by speeding up computations.

6. Addressing Ethical Considerations:

a. Data Privacy:

1. Data privacy measures were implemented, ensuring compliance with regulations and obtaining informed consent from participants.

b. Accessibility:

1. The system was designed to be accessible for individuals with visual impairments or motor limitations. Alternative input methods were explored to meet different user needs.

c. Cultural Sensitivity:

1. Cultural sensitivity was maintained to ensure appropriate representation of Marathi sign language and respect for cultural nuances.

LITERATURE STUDY

The field of sign language recognition and translation has seen significant advancements, with a variety of approaches being explored to enhance communication accessibility. Dahatonde et al. (2024) developed a system for recognizing and translating sign language to both English and Marathi, with potential applicability to Marathi Sign Language (MSL) [3]. Published in the International Journal of Creative Research Thoughts (IJCRT), their work highlights the promise of expanding language coverage, though it provides limited information on the specific sign language addressed. Patil et al. (2023), in their survey on sign language detection using smart gloves for disabled individuals, reviewed a detection system that is not directly applicable to MSL recognition [4]. While the paper, also published in IJCRT, focused on sign language detection using smart gloves, it does not address CNN-based recognition systems, making it less relevant to our project's goals. Similarly, Lomte and Doye (2022), in their work on gesturebased Devanagari text recognition using deep learning, explored the use of deep learning for gesture recognition [6]. Although this paper, published in the Journal of Harbin Institute of Technology, provides insights into gesture-based recognition, it is not directly focused on MSL or sign language translation, making its applicability limited to the scope of MSL research. On the other hand, Gajare et al. (2022) developed a system for translating sign language into text and speech, with potential relevance to MSL [5]. However, their paper, also in IJCRT, leaves details regarding the specific language supported and the methodology unclear, hindering its direct applicability to MSL recognition. A more directly relevant study by Dahibavkar et al. (2020), published in the International Journal of Latest Technology in Engineering, Management Applied Science (IJLTEMAS), proposed a CNN-based system specifically for MSL recognition [1]. This study achieved an impressive accuracy of 90recognition. However, the system's performance was limited by the size of the dataset used, highlighting the ongoing challenge of data scarcity in MSL research. In addition, Rokade et al. (2019) presented an Indian Sign Language recognition system in Marathi language text, contributing to the understanding of sign language systems [7]. Shinde and Kagalkar (2015) also explored advanced methods for Marathi sign language recognition using computer vision techniques, further supporting the development of this field [2].

Product Overview

The MSL-CNN system is an advanced solution designed to enhance communication accessibility for the deaf and hard of hearing community in Maharashtra, India. Utilizing Convolutional Neural Networks (CNNs), this system aims to accurately recognize and translate Marathi Sign Dialect (MSL) gestures into spoken Marathi text and speech. By harnessing the power of machine learning and computer vision, MSL-CNN facilitates real-time interpretation of sign language, breaking down communication barriers and promoting inclusion. Key features Fig. 2. Hand gesture from Marathi Sign Language (MSL) [2] include high-accuracy gesture recognition through a robust CNN architecture, immediate translation of recognized gestures into spoken Marathi via text-to-speech technology, and an intuitive user interface that allows for easy sign capture and feedback. The system employs a data-driven approach with continuous learning and optimization, incorporating diverse datasets to enhance accuracy and generalization. Additionally, future enhancements will explore multimodal support by integrating facial expressions and body language, ensuring a comprehensive communication experience. Designed for Fig. 2. Hand gesture from Marathi Sign Language (MSL) [2] deaf and hard-of-hearing individuals, educators, and organizations,

MSL-CNN significantly improves communication, social inclusion, and access to information, education, and employment opportunities while contributing to the broader field of sign language technology

CONCLUSIONS

This survey paper reviews advancements in Marathi Sign Language (MSL) recognition and translation using Convolutional Neural Networks (CNNs). It highlights significant progress in feature extraction and classification, but notes challenges like data limitations and the complexity of MSL.

ACKNOWLEDGMENTS

We sincerely thank Ms. Snehal Mangale and Prof. Vina Lomte for their invaluable guidance throughout this research. We also appreciate the authors of the referenced studies for their foundational work in Marathi Sign Language (MSL) recognition and translation, as well as the institutions that provided essential resources for this project.

Figures:

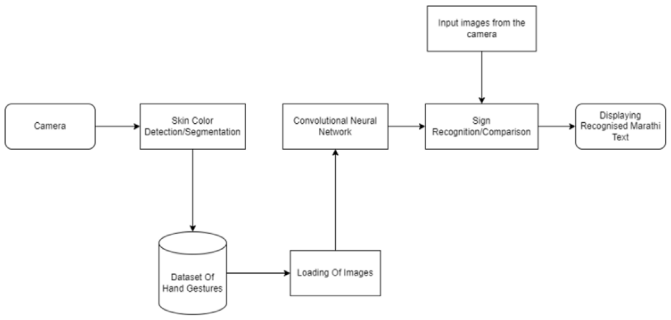

Figure 1: Methodology Flowchart for Real-Time Marathi Sign Language Recognition [1].

This flowchart illustrates the sequential process from capturing live hand gestures via a camera, followed by skin color detection/segmentation, and loading images for processing. The dataset of hand gestures is analyzed using a Convolutional Neural Network (CNN) for effective sign recognition, which subsequently converts recognized signs into Marathi text for display.

Figure 2: Hand Gesture Representations for Marathi Sign Language Alphabet [2].

This visual dataset showcases hand gestures corresponding to each letter in the Marathi alphabet, aiding in sign language recognition. Each gesture is specifically designed to represent distinct Marathi letters, facilitating accurate gesture-to-text conversion for real-time applications.

REFERENCES

1. S. Dahibavkar, J. Dhopte, M. Patole, and S. Madachane, "Marathi Sign Language Recognition," International Journal of Latest Technology in Engineering, Management & Applied Science (IJLTEMAS), vol. 9, no.5, pp. 1-5, 2020.
2. A. Shinde and R. Kagalkar, "Advanced Marathi Sign Language Recognition using Computer Vision," International Journal of Computer Applications, vol. 118, no. 13, pp. 1-5, 2015.
3. P. Dahatonde, P. Khandekar, O. Kharat, S. Saoji, and N. Jayakumar, "Sign Language Recognition and Translation to English and Marathi," International Journal of Creative Research Thoughts (IJCRT), vol. 12, no. 5, p. 481, 2024.
4. S. Patil, V. M. Lomte, Y. Pawar, S. Raysing, and A. Renuse, "Survey on Sign Language Detection Using Smart Gloves for Disabled People," International Journal of Creative Research Thoughts (IJCRT), vol. 10, no. 6, p. 276, 2023.
5. Y. Gajare, V. M. Lomte, H. Bhujbal, A. Gurav, and I. Gulanagoudar, "Hand Gesture Recognition System for Translating Sign Language into Text and Speech," International Journal of Creative Research Thoughts (IJCRT), vol. 10, no. 6, p. 276, 2022.
6. V. M. Lomte and D. D. Doye, "Gesture-Based Devanagari Text Recognition Using Deep Learning," Journal of Harbin Institute of Technology, vol. 54, no. 6, p. 238, 2022.
7. P. Rokade, N. Sali, D. Shinde, and S. Yadav, "Indian Sign

Language Recognition System in Marathi Language Text," International Journal of Computer Sciences and Engineering, vol. 7, no. 5, [Open Access Research Paper], E-ISSN: 2347-2693, 2019.

8. H. R. Khandagale, R. R. Chougale, and R. R. Jadhav, "Real Time Sign Language Recognition Based on Machine Learning Survey," International Research Journal of Modernization in Engineering Technology and Science, vol. 5, no. 4, [PeerReviewed, Open Access], E-ISSN: 2582-5208, 2023.
9. A. Sanap, V. M. Lomte, A. Joshi, A. Nasare, and S. Chandratre, "Handwritten Character Recognition from Physical Documentation," International Journal of Research and Analytical Reviews, vol. 10, no. 2, [Open Access Research Paper], EISSN: 2348-1269, P-ISSN: 2349-5138, 2023.
10. S. Patil, V. M. Lomte, Y. Pawar, S. Raysing, and A. Renuse, "ECOSH: A Novel Technique For Sign Language Detection Using IoT Based Smart Hand Gloves," Journal of Technology, vol. 12, no. 5, ISSN: 10123407, 2024.
11. A. A. Darekar, N. B. Pawar, R. D. Pawar, V. S. Sangale, and Prof. M. V. Khandekar, "Marathi Sign Language Recognition for Physically Disabled People," International Journal of Advanced Research in Science, Communication and Technology, vol. 2, no. 7, [Open Access Research Paper], E-ISSN: 2581-9429, DOI: 10.48175/IJARSCT-4435, 2022.